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The Development of Energy Conservation Demonstration Buildings in Alberta

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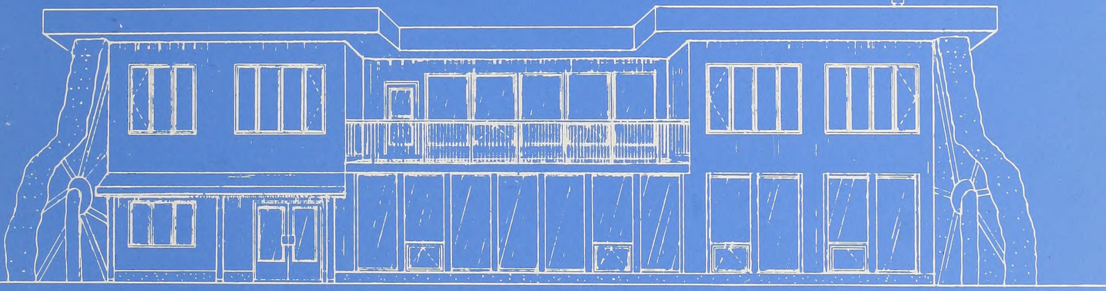
Energy Resources
Research Fund



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Foreword

Since 1976, numerous projects have been initiated in Alberta by industry and by academic research institutions which are aimed at better utilization of Alberta's energy resources.

These research, development and demonstration efforts were funded by the Alberta/Canada Energy Resources Research Fund (A/CERRF), which was established as a result of the 1974 agreement on oil prices between the federal government and the producing provinces.

Responsibility for applying and administering the fund rests with the A/CERRF Committee, made up of senior Alberta and federal government officials.

A/CERRF program priorities have focused on coal, energy conservation and renewable energy and conventional energy resources. Administration for the program is provided by staff within the Scientific and Engineering Services and Research Division of Alberta Energy.

In order to make research results available to industry and others who can use the information, highlights of studies are reported in a series of technology transfer booklets. For more information about other publications in the series, please refer to page nine.

The Development of Energy Conservation Demonstration Buildings in Alberta

During the early 1980s, when all indications pointed to higher oil prices, and public interest in energy conservation was rising, the Alberta/Canada Energy Resources Research Fund (A/CERRF) provided financial support for several demonstration projects related to conserving energy in buildings.

While most of these projects dealt with private dwellings or commercial establishments, two involved buildings open to the public to acquaint people with energy conservation concepts and technologies. These two projects are described in this booklet.

Edmonton Energy Conservation Centre

Through the efforts of the Tomorrow Foundation, a non-profit organization, and the Northern Alberta Chapter of the Solar Energy Society of Canada Inc., an older house in the Old Strathcona section of Edmonton was converted into an energy conservation demonstration centre. It was opened to the public in 1985.

The house, built in 1911 and owned by the City of Edmonton, was leased to the Tomorrow Foundation for five years at a cost of $1 a year. The two-storey dwelling, which has a full basement and 205 m^2 (2 207 sq. ft.) of floor space, needed considerable structural repair. It also had high heating costs. In fact, the City of Edmonton was having some difficulty in renting the building because tenants complained of heating costs and poor comfort levels during the winter.

The main floor and basement walls of the house were of brick masonry to the ground level and were supported on concrete walls below ground level. The upper storey was wood frame, clad with wood sheathing and cedar shingles. There was no insulation in the walls. In the attic, however, 7.6 cm (3 in.) of wood shavings were used to counteract Edmonton's low winter temperatures. The heating system comprised a natural gas-fired forced air furnace, which was used to heat the main floor, and electric baseboard heaters on the upper floor. The basement was unheated.

With this as a background, the objectives of the project were to lower fuel consumption, reduce heat losses and improve the comfort level of the house while employing retrofit techniques which could be demonstrated and recommended to the public. Therefore, the retrofits became an integral part of the public displays.

To achieve the objective of converting the house to an energy conservation demonstration centre, the Tomorrow Foundation received financial support from A/CERRF to help defray renovation and retrofitting costs and to operate the demonstration centre for one year. Additional assistance, in the form of grants, volunteered labour and materials, was provided by several federal and provincial government departments, individuals, companies and technical institutes.

Renovation and retrofitting began in June 1984. Unemployed tradesmen were hired to supervise relatively unskilled youth workers from the Katimavik Youth Development Program of the federal government. Architectural services were provided by Sun Earth Designs Ltd., while technical advice was obtained from a technical review committee.

The construction plan included remedies for several structural problems. In the basement, for example, joists and beams supporting the main floor were undersized, the floor was uneven, and supporting posts and columns were in disrepair. Also, headroom in the basement was inadequate. It was discovered that the sewer connection to the main line was in poor condition. This caused frequent sewer backups. As well, the chimney stack had deteriorated to such an extent that demolition was required.

Retrofit Work

Main Floor

The drywall ceilings above the main floor were removed to provide access for rewiring and installing new heating and ventilation ductwork. Rigid styrofoam was inserted between floor joists, flush with exterior walls, and sealed with flexible acoustical sealant or compressible foam polyethylene backer rod.

To overcome air infiltration around the perimeter of the subfloor, all gaps and joints were caulked above and below the floor. Also, the base of gypsum board walls was sealed to the subfloor or overlay.

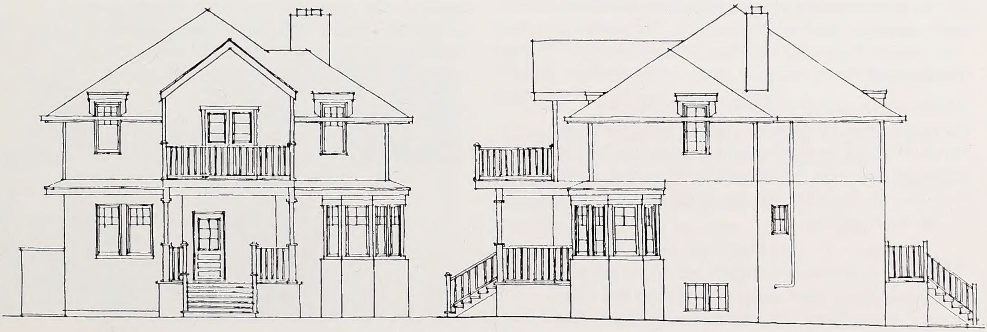
In considering methods for insulating the main floor and basement exterior walls, it was noted that if insulation were placed on the interior of brick walls in older buildings it would isolate the masonry from any source of heat during the winter. This might hasten deterioration of the brick. On the other hand, it would have been difficult and expensive to add insulation to the exterior of the house. This would also alter the appearance of the house, which was discouraged because it is located in a building preservation area. Consequently, insulation and vapour barriers were added to the interior of the walls and monitoring devices were installed to detect significant changes in the temperature of the masonry.

Upper Floor

Drywall on the upper floor walls and ceiling was left in place. Cellulose insulation was blown into the uninsulated wall cavity. Rigid styrofoam was used to insulate the ceilings. Walls were sealed in the same manner as on the main floor.

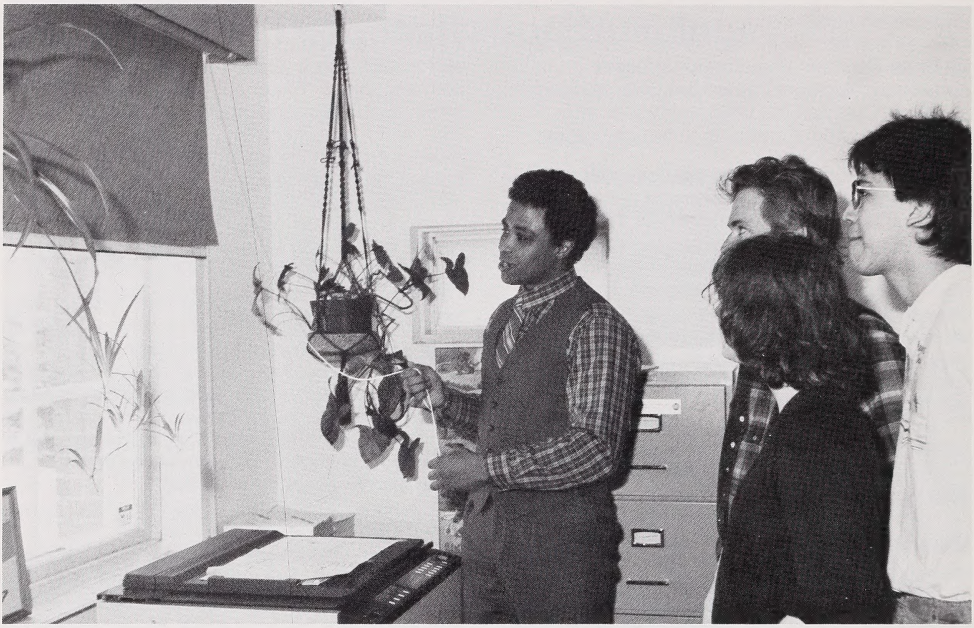
Basement

A new wall, using 5.1 cm x 15.2 cm (2 in. x 6 in.) framing, and built inside the original basement wall, was insulated with fibreglass batts. The walls and ceiling were sealed at joints. A new basement floor was installed without insulation, but for demonstration purposes a small area was fitted with rigid styrofoam and a plywood floor.



North and west elevations of the Edmonton Energy Conservation Centre.

(Source: *Edmonton Energy Conservation Centre Final Report — Phase I Retrofit,* Tomorrow Foundation, May 1985)



In the office/reception area, an insulating curtain is used on the window.

(Source: *Edmonton Energy Conservation Centre Final Report — Phase II*, Staszenski, B., March 1986)

Exterior

Although alterations to the above-grade exterior were kept to a minimum to satisfy the architectural controls in effect in Old Strathcona, it was possible to add rigid styrofoam to the lower portion of the walls to a depth of 61 cm (2 ft.) below grade, with 61 cm (2 ft.) added at right angles to the wall at that depth.

Windows

Windows received various treatments for demonstration purposes. This included sealing some in place, installing vinyl-frame double- or triple-glazed units on the south side and using exterior roll shutters, interior roll shades and thermal curtains on others.

Attic

Wherever pipes and wires penetrated the attic space, some form of sealant was applied. The existing wood shavings were supplemented by cellulose insulation.

Heating and Ventilation Systems

The entire heating system was replaced by a high-efficiency gas-fired furnace, which supplies forced air to all three floors. Hot water is supplied by an induced-draft, side-venting, gas-fired water heater. A demonstration hot water radiant heating system was installed in one basement room. It comprises water circulation tubes embedded in concrete and supplied with hot water by a separate, high-efficiency, gas-fired boiler.

A heat recovery ventilator removes air from the kitchen, bathrooms and laundry area, and supplies fresh air to the furnace room.

Energy Conservation Education

The renovated and retrofitted house, known as the Edmonton Energy Conservation Centre, was officially opened to the public on February 28, 1985. For the next year, A/CERRF provided funds to operate the centre and develop information programs relating to residential energy conservation.

Open hours are from 12:00 to 4:30 p.m. Monday to Friday. The centre is closed on weekends. Evenings are set aside for courses, seminars and meetings.

Visual Display

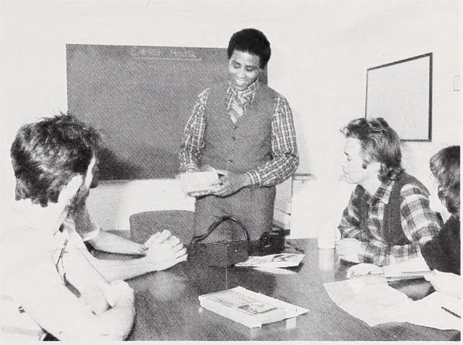
A visual display system was developed. It is organized into six components: (1) air sealing, (2) insulation, (3) heating/ventilation systems, (4) hot water use, (5) passive solar and (6) other energy management concepts.

The air-sealing component promotes awareness about energy losses caused by air infiltration and shows how low-cost materials can reduce heat losses and provide moisture control. The component comprises elements on weather stripping, caulking and vapour barriers.

Conductive heat loss and how it can be minimized by insulating materials are both explained in the insulation component. Techniques, materials and costs for installation in attics, basements and walls are covered.

In the heating/ventilation systems component, the importance of having properly sized heating systems is stressed. Also, the issues surrounding air quality, sealing and air-to-air heat exchangers are presented.

Included among the visual displays is a component on window coverings.



Seminars and workshops are offered throughout the year.

In the hot water use component, the emphasis is on methods for reducing energy consumption associated with water use. Water conservation and recycling in the home are covered in the component featuring other energy management concepts, along with electricity management and interior space use.

In the passive solar component, proper placement of windows, types of windows and the use of solar heating systems are stressed.

Visitors to the centre can learn from displays, video presentations and printed materials. The latter are supplied by various government departments and companies providing energy conservation products and services. Guided tours and special group tours can be arranged. Referrals to other agencies and sources of information are provided by centre staff.

In co-operation with the Energy Conservation Branch of Alberta Energy, workshops have been offered on topics such as energy-efficient new home construction, residential retrofits, heating and ventilation systems and the basics of residential energy conservation. Also, product promotions by industry can be accommodated.

Centre staff have been instrumental in organizing energy awareness events, and open house gatherings have been held to promote and publicize the acquisition of new equipment or the introduction of new services. Various types of promotional materials and activities are used to inform the public of the centre's services.

Energy Efficient Community Centre

Before work began on the Edmonton Energy Conservation Centre, A/CERRF in 1981 funded the design of an energy-efficient community centre in a small Alberta hamlet. The design envisaged a building which would incorporate, and be a show-place for, several energy conservation technologies.

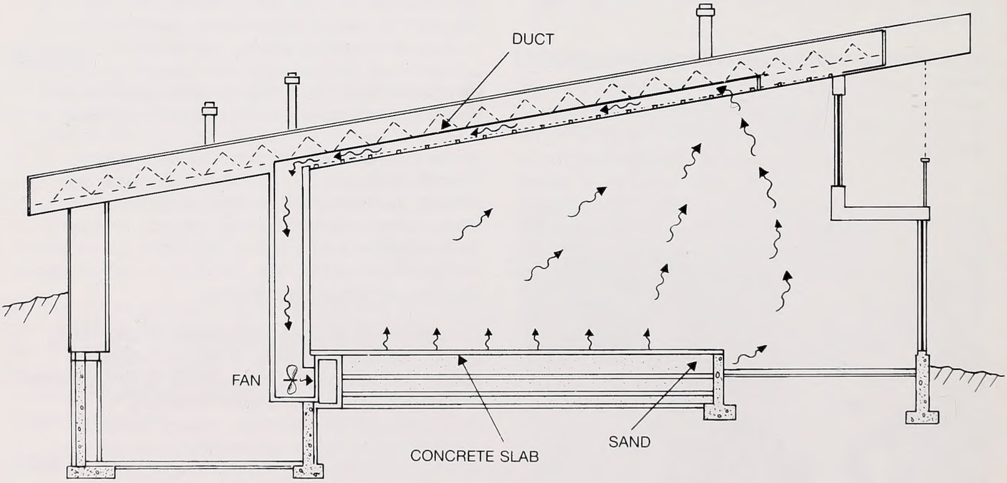
The centre was designed for Anzac, a community located approximately 56 km (35 mi.) southeast of Fort McMurray, Alberta. The site chosen for the building was flat and had an unobstructed southern exposure. It was flanked by mature forest on the other three sides.

In discussions with community leaders, the designer, Sunergy Systems Ltd. of Cremona, Alberta, learned that the centre was expected to accommodate a wide diversity of interests. For example, it was to hold up to 150 people for dances, suppers and public meetings, while also serving as a quiet meeting place for small groups. It was expected that certain recreational activities could be accommodated, and that space would be available for craft classes, a community office, a health facility, a greenhouse and meeting or lounge areas.

At first, it seemed to the designer that this range of expectations was impossibly broad; however, it realistically reflected the needs of many small communities. The designer was further asked to create a building "from the land, of the land."

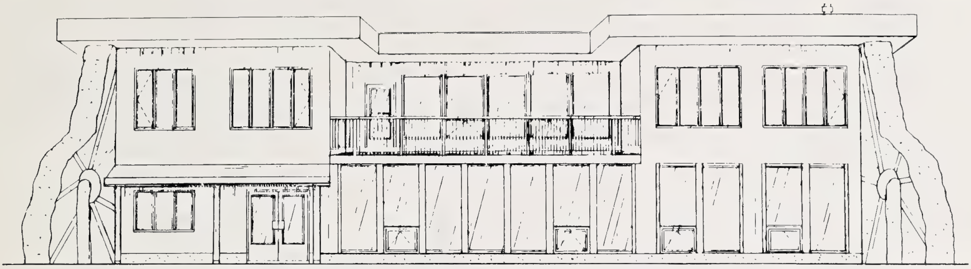
This request became the central element of the design. The designer chose to take advantage of the ready availability of timber and, with community labour, used stackwall construction. The concept, which has been used sparingly in Canada for the last 100 years, involves seating one end of short lengths of dried logs in mortar, while the remainder of each log is surrounded by loosefill insulation. The result resembles a stack of firewood. In the final design, stackwall was chosen for the north, east and west walls, using 76-cm (30-in.) lengths of wood, covered with building paper and earth-coloured stucco to minimize air infiltration.

The south wall was intended to be balloon-framed with a considerable area devoted to windows. The remainder of the wall was to be covered with board and batten siding. A simple shed roof was to be used. It would be finished with factory-painted, dark brown metal roofing.



Conceptual drawing of solar heat storage and release system for Anzac Community Centre.

(Source: *The Design of the Anzac Community Centre*, Kerfoot, M., Sunergy Systems Ltd., January 1983)



Conceptual drawing of Anzac Community Centre.

(Source: *The Design of the Anzac Community Centre*, Kerfoot, M., Sunergy Systems Ltd., January 1983)

The final plan envisaged a bi-level structure incorporating a large activity area, a sunspace/ greenhouse, an office for visiting health professionals, a "stovewood" lounge, a craft room, a reading lounge, a community office, space for a small stage, a kitchen and washrooms. The total usable space was 370 m^2 (3 983 sq. ft.).

Most of the solar gain in the greenhouse and other activity areas was intended to be absorbed initially by a concrete slab floor. Any excess heat would move toward the ceiling where ducts would direct the heated air to the north side of the building. An extraction fan located in the ducts would be activated whenever the ceiling temperature reached a predetermined level. On the building's north side, the warm air would enter pipes embedded in compacted sand under the concrete floor. The sand would be insulated from the surrounding soil by the use of 7.6-cm (3-in.) thick styrofoam. After heat was transferred to the sand (from which it would be released slowly as the building began to cool), the cooled air would be returned to the greenhouse. To minimize heat loss through the glazing at night, double-layered, reflective insulating curtains were to be used.

The building was designed to have insulation levels of RSI 7.0 (R40) on the north, east and west sides, RSI 6.0 (R34) on the south side and RSI 10.5 (R60) in the ceilings. A thermal analysis of the design indicated that annual space heating costs of less than $100 should be anticipated. Auxiliary heat would be provided by a small propane furnace.

While it was believed that an air-to-air heat exchanger would not be required, the design included provision for one at a later date.

Estimated building costs in 1981 were approximately $250 000 to $500 000. Although ability to finance the project was not an issue, community leaders decided not to proceed with construction. Nevertheless, the design and the low space heating costs it was expected to incur represented a significant accomplishment for northern buildings. It was believed that the design was worth emulating by other communities.

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Additional copies of this publication are available from:

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Other publications in this series which are available and deal with energy conservation include:

A Practical Method for Defouling Heat Exchangers,
6 pages, March 1986.

Energy Management in Commercial Buildings,
8 pages, December 1986.

Control of Heat Loss Associated with Overhead Doors,
6 pages, January 1987.

Practical Methods to Seal and Insulate Residential Buildings,
9 pages, March 1987.

Energy-Conserving Characteristics of Common Building Materials and Methods,
14 pages, April 1987.

Performance Characteristics of Energy-Efficient Residential Furnaces,
9 pages, April 1987.

Some Methods of Insulating Basements, Walls and Windows,
10 pages, July 1987.

A Programmable Controller for Parking Lot Block Heaters,
9 pages, March 1988.

Some Methods of Saving Energy with Fluorescent Lighting,
8 pages, March 1988.

Methods for the Recovery and Reuse of Waste Heat in Some Commercial Operations,
9 pages, August 1988.

Some Energy-Conserving Concepts for Residential Buildings,
14 pages, November 1988.

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